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Job No.: PDX 30702.PA.NP

Subject: Mixing Zone Issues

Date: 12 Nov 91

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REMARKS: Other topics for meeting agenda:

(1) Discuss responsibility of canneries with respect to WQS violations

(2) Effluent limits vs. WQS; idea of "net loading capacity" (?)

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MEMORANDUM CH2MHILL

TO: Doug Liden/USEPA
(your reference: W-5-1)

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Norman Lovelace/USEPA
Norman Wei/StarKist Seafood
James Cox/Van Camp Seafood

FROM: Steve Costa/CH2M HILL

DATE: 12 November 1991

SUBJECT: Joint Cannery Outfall Mixing Zone Issues

PROJECT: PDX30702.PA.NP

PURPOSE

Included in USEPA's letter transmitting Limno-Tech's review of the Joint Cannery Outfall Zone of Mixing Application (Pago Pago Harbor, American Samoa) were questions on two additional issues.

- American Samoa Water Quality Standards (ASWQS) with respect to un-ionized ammonia in the zone of mixing
- Proposed mass limits based on zone of mixing analysis

The purpose of this memorandum is to respond to your concerns and questions regarding these items.

ASWQS and AMMONIA

Contrary to the interpretation expressed in the letter, ASWQS do not expressly state that toxic substances are not allowed within the mixing zone. Sections of the ASWQS quoted in the letter state:

[1] Section 24.0208 (b) (5) says that "determination of effluent limits for toxic substances must comply with Section 24.0207 (a) (8) (A)-(E) and 24.0207 (a) (9);"

[2] Section 24.0208 (b) (6) says that "standards set forth in 24.0207 (a) (1)-(4) shall be met within a zone of mixing;"

Our interpretation of the ASWQS is that limits for toxic substances should be determined per USEPA guidance based on dilution at the edge of the zone of mixing (ZOM) and the edge of the zone of initial dilution (ZID). Our interpretation is based on the following:

- Addressing the second point [2] above: 24.0207 (a) says "the following standards apply to all ... waters ... except as otherwise provided in Section 24.0208 (Zones of Mixing)."

- Section 24.0207 (a) (4) says: "[waters] shall be substantially free from substances and conditions ... which may be toxic ...". We interpret "substantially free" to imply that there are limits to toxic substances. Any other interpretation would lead to a situation that would virtually prohibit any discharge at all into any waters.

- The first point [1] above clearly states that limits for toxic substances are recognized in the mixing zone and those limits must comply with certain provisions.

- In particular Section 24.0207 (a) (8) (D) specifically states " ... effluent limits based on acute and/or chronic toxicity tests of effluents may be prescribed by EQC." Which again implies the establishment of limits.

The ASWQS provide for the acceptance of limits of toxic substances within the mixing zone. The criteria of the ASWQS therefore don't necessarily apply at the end of the pipe if a mixing zone is permitted. However, the standards do not address the method for determining limits.

It is expected that the limits should be determined based on USEPA guidance (Technical Support Document for Water Quality-based Toxics Control, EPA/505/2-90-001, 1991). The USEPA guidance generally allows the criteria maximum concentration (CMC) to be met at the edge of the ZID and the criteria continuous concentration (CCC) at the edge of the ZOM.

The CMC and CCC for un-ionized ammonia are provided in Attachment 1 to your letter. These values are given as 0.233 and 0.035 mg/l, respectively.

CRITERIA AT EDGE OF THE ZID

The regulatory ZID can be defined a number of ways and the most restrictive is then taken to apply. If the CMC cannot be met at the edge of the ZID then an alternative ZID may be defined. For the proposed diffuser the most restrictive definition is 50 times the discharge length scale which is, for a port diameter of 5 inches, 18.5 feet (5.6 meters). For maximum effluent discharge (worst case conditions) the dilution at a distance of 5.6 meters from the diffuser port is approximately 25 to 30 (see Appendix A of the Zone of Mixing Technical Memorandum, CH2M HILL, August 26, 1991).

The only ammonia value available for StarKist Samoa effluent, since implementation of high-strength waste segregation, is 78.5 mg/l, the maximum pH value for StarKist Samoa is 8.2. This value for pH was measured one time (September 8, 1990) during a 12 month period for a total of 45 minutes. Typical daily maximum pH values are 7.2 or less. Assuming a maximum temperature of 30 degrees C, the associated un-ionized ammonia value would be 8.87 mg/l. A dilution of 30 then gives a value of 0.296 mg/l at the edge of the most restrictive regulatory ZID boundary. This is compared to the CMC of 0.233 mg/l. Since the most restrictive of the regulatory ZID dimensions will not apply an alternative ZID should be determined.

The intent of defining a ZID boundary is to minimize exposure time of organisms to elevated concentrations. Typically the exposure time should be on the order of minutes. Using the results from the dilution models (zero current, maximum effluent flow case) exposure times of 30, 60, and 90 seconds correspond to dilutions of approximately 80, 170, and 275. These dilutions would result in concentrations of 0.111, 0.0522, and 0.0323 mg/l at distances of approximately 12, 20.5, and 28.5 meters from the diffuser, respectively.

The only ammonia value available for Samoa Packing effluent, since the implementation of high-strength waste segregation, is 57.8 mg/l, the maximum pH value for Samoa Packing is 9.1. However, seawater maximum pH in near surface waters is about 8.4, the highest observed in Pago Pago Harbor is about 8.2 to 8.3. The 9.1 value for Samoa Packing was only observed once and the next closest maximum was 8.4. Using a value of 8.4 and assuming a maximum temperature of 30 degrees C, the associated un-ionized ammonia value would be 9.71 mg/l. A dilution of 30 then gives a value of 0.323 mg/l at the edge of the most restrictive ZID boundary. This is compared to the CMC of 0.233 mg/l. The result is similar to the above calculations for StarKist Samoa effluent and an alternative ZID should be determined.

Following the same procedure as described above for StarKist Samoa, and using the results from the dilution models (at zero current, maximum effluent flow) for exposure times of 30, 60, and 90 seconds. Concentrations of 0.121, 0.0571, and 0.0353 mg/l at distances of approximately 12, 20.5, and 28.5 meters from the diffuser, respectively, are calculated.

For the worst case effluent flow and ambient conditions, the initial dilution process is over at a distance of about 33 meters corresponding to a dilution of approximately 350 and an exposure time of about 110 seconds. This is the edge of the physically defined ZID. The calculations above indicate that a regulatory ZID can be defined at or within the boundary of the physical ZID and meet the intent of minimizing exposure time of organisms.

CRITERIA AT EDGE OF THE ZOM

At the end of the initial dilution process the minimum dilution is approximately 350. The calculated un-ionized ammonia concentrations at this point are approximately, combining waste streams from both canneries, 0.025 mg/l. At the edge of the proposed mixing zone the minimum dilution is over 2000. The un-ionized ammonia concentration is calculated to

be about 0.0044 mg/l at the edge of the ZOM. This is compared to the CCC of 0.035 mg/l. The concentration at the edge of the physical ZID and throughout the rest of the mixing zone is lower than the CCC.

Typical background levels of un-ionized ammonia in surface sea water are expected to be in the range of 0.0005 to 0.005 mg/l at the temperature under consideration. For a rigorous analysis the values calculated above should account for the background values. Background or ambient harbor values are not known. However, considering typical marine values, it is obvious that the differences in results that would be obtained by accounting for background values will not significantly change the overall results.

SUMMARY

The ASWQS allow the determination of limits for substances such as un-ionized ammonia. Following USEPA guidelines the concentrations at the edge of the physical ZID and the edge of the ZOM appear to be consistent with national water quality criteria. There is no indication, based on available data, that any additional treatment is justified.

MASS LIMITS IN MIXING ZONE

The mass limits that are compatible with the mixing zone location and averages cover a range of possible conditions. The model predictions were done based on long term averages with superimposed maximum peaks. A low average loading permits a higher peak value than a high average. For example: the mixing zone analysis indicates that a monthly median loading of total nitrogen (TN) of 2000 pounds per day with a maximum of 4000 pounds per day is compatible with the proposed mixing zone. The analysis also indicates that a monthly median loading of total phosphorus (TP) of 400 pounds per day with a maximum of 800 pounds per day is compatible with the proposed mixing zone.

The averages presented in the discussion above assume that the daily loadings are continuous. If the canneries run on a weekly cycle with no, or small, loadings discharged on the weekends then the average loadings during production days are 2800 pounds per day of TN and 560 pounds per day of TP. The maximums of 4000 pounds per day of TN and 800 pounds per day of TP could occur for no more than 3 days consecutively.

Since the response time of Pago Pago Harbor is relatively slow (on the order of weeks), and the variability in TN and TP loadings from day to day is quite high (factor of >2 on production days), the best approach to mass loadings is to consider daily averages based on total monthly loadings with allowance for non-production days and peaks as described above. The example above would then translate to:

EXAMPLE COMBINED LIMIT FOR TOTAL NITROGEN

- Monthly (30 day) average of 2000 pounds/day which represents a total loading of 60000 pounds per month
- Daily average for production days not to exceed 2800 pounds per day
- Maximum loading in any one day not to exceed 4000 pounds for more than 3 consecutive days (4300)

EXAMPLE COMBINED LIMIT FOR TOTAL PHOSPHORUS

- Monthly (30 day) average of 400 pounds/day which represents a total loading of 12000 pounds per month
- Daily average for production days not to exceed 560 pounds per day
- Maximum loading in any one day not to exceed 800 pounds for more than 3 consecutive days (580)

These values account for the present loadings and provide capacity for increased future loadings. The values are documented in Tables 2, 14, and 15 of the Zone of Mixing Technical Memorandum. Review of the information in the Technical memorandum indicates that these values provide a factor of safety superimposed on already conservative prediction techniques and assumptions.

The two canneries will each have individual NPDES permits and individual discharge limits will be established for each cannery as described in USEPA letters (June 20th, 1991) to each cannery which state:

> *"Based on USEPA's analysis of the data in each permit application, past Discharge Monitoring Reports (DMR's) and other appropriate data, USEPA will issue a separate NPDES permit to each cannery which will establish separate effluent discharge limits for each cannery at a point prior to the effluent's entry into the joint pipeline.*

The loadings established for each cannery should involve a negotiated agreement between the canneries with concurrence of USEPA and ASG. However, an approved mixing zone should be substantially complete prior to the implementation of such an agreement. We should discuss the next steps in this process at our meeting on 13 November 1991.